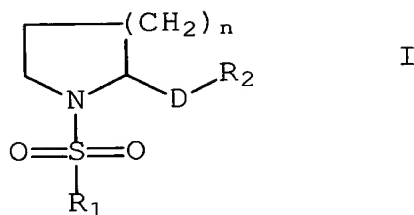


What is claimed is:

1. A compound having the formula (I):



where

n is 1-3;

R₁ is selected from the group consisting of hydrogen, C₁-C₉ straight or branched chain alkyl, C₂-C₉ straight or branched chain alkenyl, aryl, heteroaryl, carbocycle, or heterocycle;

D is a bond, or a C₁-C₁₀ straight or branched chain alkyl, C₂-C₁₀ alkenyl or C₁-C₁₀ alkynyl;

R₂ is a carboxylic acid or a carboxylic acid isostere;

wherein said alkyl, alkenyl, alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or carboxylic acid isostere is optionally substituted with one or more substituents selected from R³, where

R³ is hydrogen, hydroxy, halo, haloalkyl, thiocarbonyl, alkoxy, alkenoxy, alkylaryloxy, aryloxy, arylalkyloxy, cyano, nitro, imino, alkylamino, aminoalkyl, sulfhydryl, thioalkyl, alkylthio, sulfonyl, C₁-C₆ straight or branched chain alkyl, C₂-C₆ straight or branched chain alkenyl or alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or CO₂R⁴ where R⁴ is hydrogen or C₁-C₉ straight or branched chain alkyl or alkenyl;

or a pharmaceutically acceptable salt, ester or solvate thereof;

provided that:

when D is a bond, and R₂ is COOH,
then R₁ cannot be substituted naphthyl;
further provided that:

when D is a bond, and n is 1, and R₂ is COOH or CONHR₃,
then R₁ is not hydroxyl, methyl, ethyl, substituted or
unsubstituted thioethyl, benzothiazole, substituted
benzopyran, substituted benzopyrrole, substituted
benzoxazole, substituted 5-membered heterocycle
containing two N and one S heteroatoms, or substituted
or unsubstituted phenyl, phenylethyl, naphthyl, pyridyl,
thienyl, quinoline, tricyclic ring, aminoethyl, or
benzyl;

further provided that:

when D is a bond, and n is 2, and R₂ is COOH or
phenylbutyl ester,
then R₁ is not substituted phenyl, or a substituted
bicyclic ring containing two oxygen heteroatoms.

further provided that:

when D is a bond, and n is 1-2, and R₂ is a substituted
or unsubstituted carbocyclic or heterocyclic ring
structure,
then R₁ is not substituted or unsubstituted carbocycle
or heterocycle, or hydroxy;

further provided that:

when D is a bond, and n is 1-2, and R₂ is hydroxy,
alkoxy, -SO₂(phenyl), N(R₃)₂, substituted thio or
alkylthio, -NCO, -PO₃(Me)₂, or -NCOOC(ethyl)phenyl,
then R₁ is not naphthalene, ethylene, substituted
tricyclic ring, or substituted or unsubstituted phenyl;

further provided that:

when D is C₁-C₃ alkyl or hexenyl, and R₂ is hydroxyl,
then R₁ is not substituted or unsubstituted phenyl, or
benzoimidazole;

further provided that:

when D is methyl, and n is 1, and R₂ is cyano or COOH,

then R₁ is not substituted phenyl;

further provided that:

when D is methyl, and n is 1, and R₂ is methoxy or N(R₃)₂,

then R₁ is not methyl, ethyl, phenylethyl, chloro substituted alkyl, substituted oxirane, substituted aziridine wherein one of the carbons is replaced with an oxygen, substituted or unsubstituted propenyl, substituted phenyl, benzyl, or trifluoro substituted C₂-C₃ alkyl or alkenyl;

further provided that:

when D is ethyl, and n is 2, and R₂ is hydroxyl or N(R₃)₂,

then R₁ is not naphthyl;

further provided that:

when D is propyl, and n is 1, and R₂ is methoxy,

then R₁ is not ethylene, cyano substituted ethyl, or triethoxy substituted propyl;

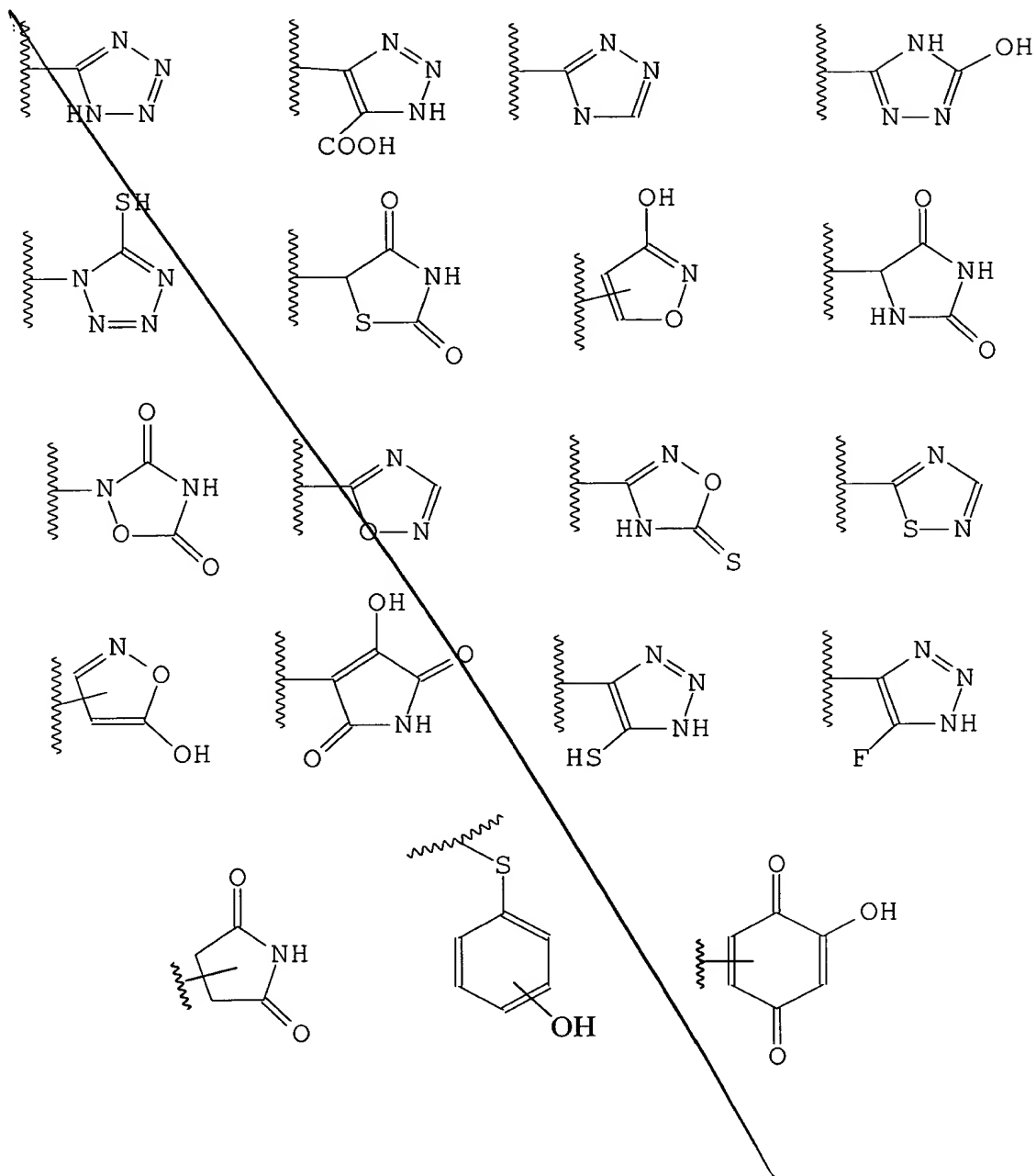
further provided that:

when D is not a bond and at least one of D and R₂ contains at least one S or O,

then R₁ is not methyl or substituted phenyl.

2. The compound of claim 1, wherein R₂ is a carbocycle or heterocycle containing any combination of CH₂, O, S, or N in any chemically stable oxidation state, wherein any of the atoms of said ring structure are optionally substituted in one or more positions with R³.

3. The compound of claim 1, wherein R₂ is selected from the following group:



where the atoms of said ring structure may be optionally substituted at one or more positions with R^3 .

70. The composition of claim 67, wherein R_2 is selected from the group consisting of:

-COOH, -SO₃H, -SO₂HNR³, -PO₂(R³)₂, -CN, -PO₃(R³)₂, -OR³, -SR³, -NHCOR³, -N(R³)₂, -CON(R³)₂, -CONH(O)R³, -CONHNHSO₂R³, -CONHSO₂R³, and -CONR³CN.

71. The composition of claim 65, wherein the carboxylic acid or carboxylic acid isostere is selected from the group consisting of compounds 1-97.

add A₅
add B₁

where the atoms of said ring structure may be optionally substituted at one or more positions with R^3 .

4. The compound of claim 1, wherein the carboxylic acid or carboxylic acid isostere of R_2 is selected from the group consisting of:

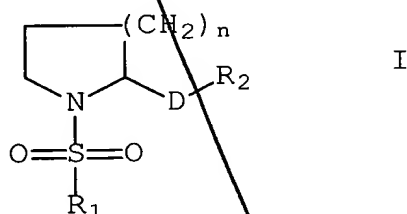
$-\text{COOH}$, $-\text{SO}_3\text{H}$, $-\text{SO}_2\text{HNR}^3$, $-\text{PO}_2(\text{R}^3)_2$, $-\text{CN}$, $-\text{PO}_3(\text{R}^3)_2$, $-\text{OR}^3$, $-\text{SR}^3$, $-\text{NHCOR}^3$, $-\text{N}(\text{R}^3)_2$, $-\text{CON}(\text{R}^3)_2$, $-\text{CONH}(\text{O})\text{R}^3$, $-\text{CONHNHSO}_2\text{R}^3$, $-\text{COHNSO}_2\text{R}^3$, and $-\text{CONR}^3\text{CN}$.

5. The compounds, (2S)-1-(phenylmethyl)sulfonyl-2-hydroxymethyl pyrrolidine; (2S)-1-(phenylmethyl)sulfonyl-2-pyrrolidinetetrazole.

6. A pharmaceutical composition, comprising:

- an effective amount of an N-linked sulfonamide of an N-heterocyclic carboxylic acid or carboxylic acid isostere; and
- a pharmaceutically acceptable carrier.

7. The pharmaceutical composition of claim 6, wherein the N-linked sulfonamide of N-heterocyclic carboxylic acid or carboxylic acid isostere comprises a compound of formula (I):



where

n is 1-3;

365031 92240260
R₁ is selected from the group consisting of hydrogen, C₁-C₉ straight or branched chain alkyl, C₂-C₉ straight or branched chain alkenyl, aryl, heteroaryl, carbocycle, or heterocycle;

5 D is a bond, or a C₁-C₁₀ straight or branched chain alkyl, C₂-C₁₀ alkenyl or C₂-C₁₀ alkynyl;

R₂ is a carboxylic acid or a carboxylic acid isostere; wherein said alkyl, alkenyl, alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or carboxylic acid isostere is optionally substituted with one or more substituents selected from R³, where

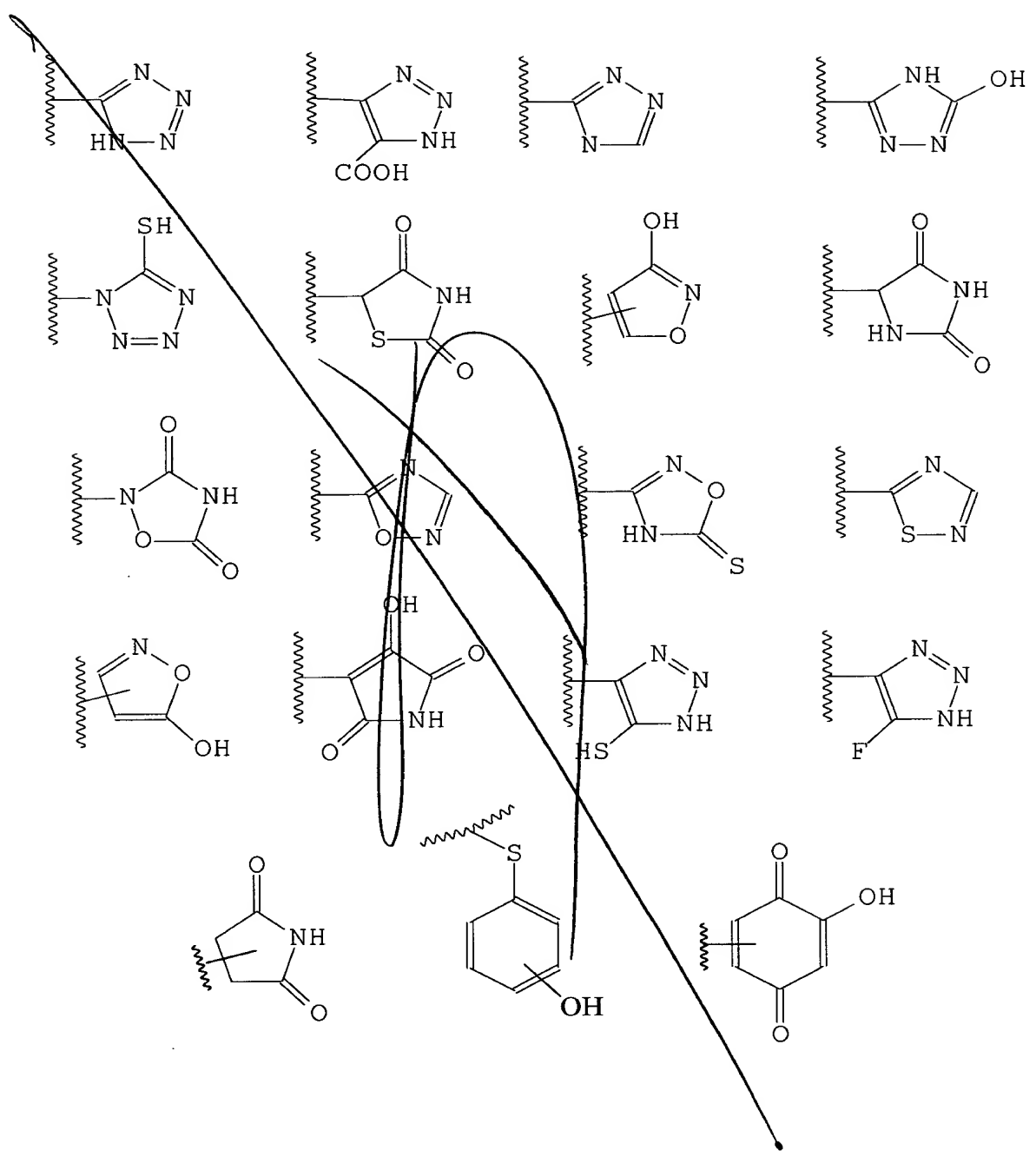
10 R³ is hydrogen, hydroxy, halo, haloalkyl, thiocarbonyl, alkoxy, alkenoxy, alkylaryloxy, aryloxy, arylalkyloxy, cyano, nitro, imino, alkylamino, aminoalkyl, sulfhydryl, thioalkyl, alkylthio, sulfonyl, C₁-C₆ straight or branched chain alkyl, C₂-C₆ straight or branched chain alkenyl or alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or CO₂R⁴ where R⁴ is hydrogen or C₁-C₉ straight or branched chain alkyl or alkenyl;

15 20 or a pharmaceutically acceptable salt, ester or solvate thereof.

25 8. The pharmaceutical composition of claim 7, wherein R₂ is a carbocycle or heterocycle containing any combination of CH₂, O, S, or N in any chemically stable oxidation state, wherein any of the atoms of said ring structure are optionally substituted in one or more positions with R³.

30 9. The pharmaceutical composition of claim 7, wherein R₂ is selected from the following group:

05027 92240260



where the atoms of said ring structure may be optionally substituted at one or more positions with R^3 .

10. The pharmaceutical composition of claim 7, wherein R_2 is selected from the group consisting of:

-COOH, -SO₃H, -SO₂HNR³, -PO₂(R³)₂, -CN, -PO₃(R³)₂, -OR³, -SR³, -NHCOR³, -N(R³)₂, -CON(R³)₂, -CONH(O)R³, -CONHNHSO₂R³, -COHNSO₂R³, and -CONR³CN.

11. The pharmaceutical composition of claim 7, wherein the N-linked sulfonamide of an N-heterocyclic carboxylic acid compound is selected from the group consisting of compounds 1-97.

12. The pharmaceutical composition of claim 6, further comprising a neurotrophic factor different from formula (I).

13. The pharmaceutical composition of claim 12, wherein said neurotrophic factor different from formula (I) is selected from neurotrophic growth factor, brain derived growth factor, glial derived growth factor, ciliary neurotrophic factor, insulin growth factor and active truncated derivatives thereof, acidic fibroblast growth factor, basic fibroblast growth factor, platelet-derived growth factors, neurotrophin-3 and neurotrophin 4/5.

14. A method of treating a neurological disorder in an animal, comprising:

administering to the animal an effective amount of an N-linked sulfonamide of an N-heterocyclic carboxylic acid or carboxylic acid isostere to stimulate growth of damaged peripheral nerves or to promote neuronal regeneration.

15. The method of claim 14, wherein the neurological disorder is selected from the group consisting of peripheral neuropathies cause by physical injury or disease state, physical damage to the brain, physical damage to the spinal cord, stroke associated with brain damage, and neurological disorders relating to neurodegeneration.

16. The method of claim 14, wherein the neurological disorder is selected from the group consisting of Alzheimer's Disease, Parkinson's Disease, and amyotrophic lateral sclerosis.

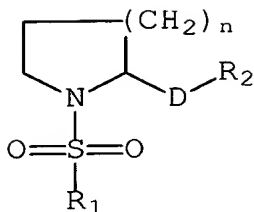
17. The method of claim 14, wherein the neurological disorder is Alzheimer's disease.

18. The method of claim 14, wherein the neurological disorder is Parkinson's disease.

19. The method of claim 14, wherein the neurological disorder is amyotrophic lateral sclerosis.

20. The method of claim 14, wherein the N-linked sulfonamide of an N-heterocyclic carboxylic acid or carboxylic acid isostere is non-immunosuppressive.

21. The method of claim 14, wherein the N-linked sulfonamide of an N-heterocyclic carboxylic acid or carboxylic acid isostere comprises a compound of formula (I):



I

where

n is 1-3;

R₁ is selected from the group consisting of hydrogen, C₁-C₉ straight or branched chain alkyl, C₂-C₉ straight or branched chain alkenyl, aryl, heteroaryl, carbocycle, or heterocycle;

D is a bond, or a C₁-C₁₀ straight or branched chain alkyl, C₂-C₁₀ alkenyl or C₂-C₁₀ alkynyl;

R₂ is a carboxylic acid or a carboxylic acid isostere;

wherein said alkyl, alkenyl, alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or carboxylic acid isostere is optionally substituted with one or more substituents selected from R³, where

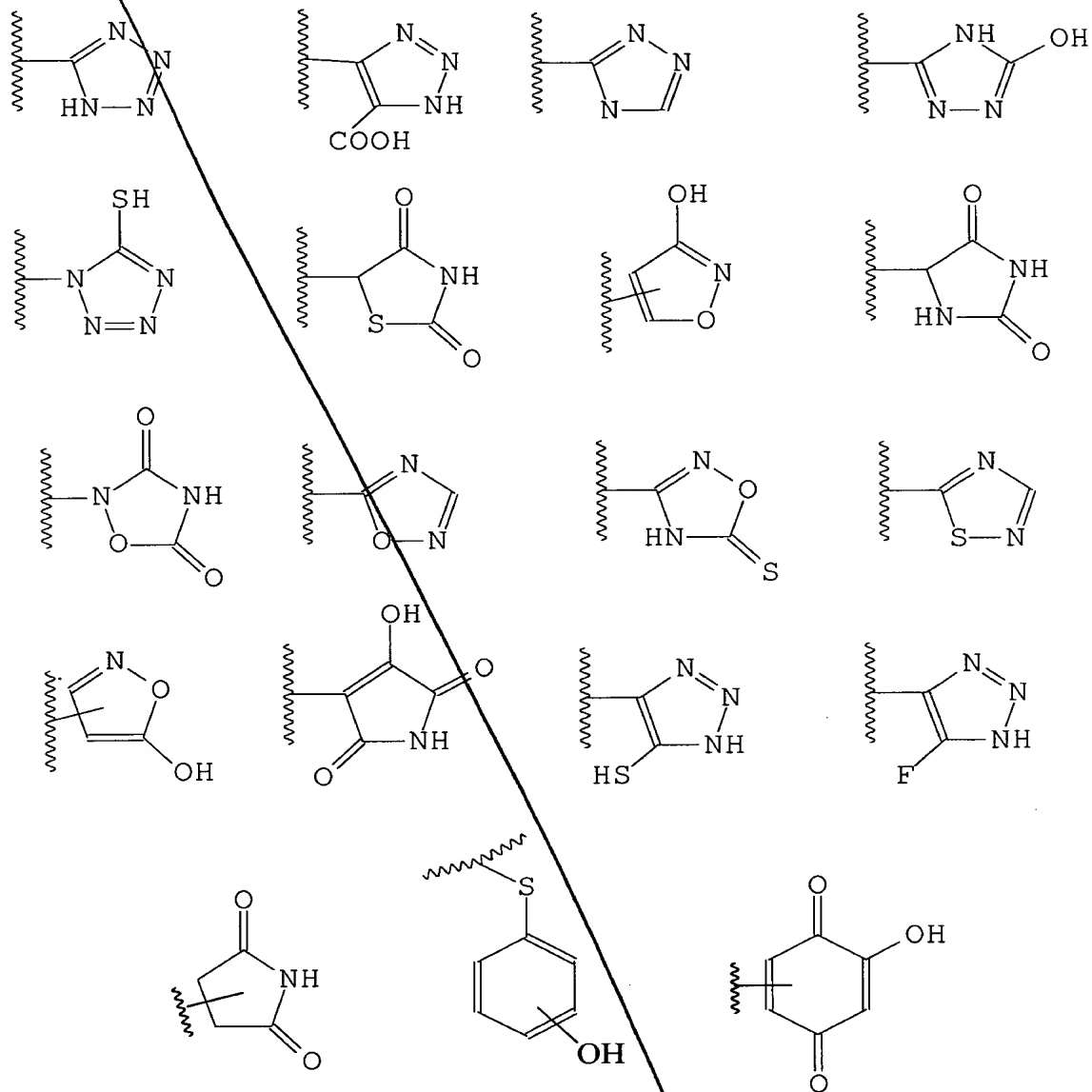
R³ is hydrogen, hydroxy, halo, haloalkyl, thiocarbonyl, alkoxy, alkenoxy, alkylaryloxy, aryloxy, arylalkyloxy, cyano, nitro, imino, alkylamino, aminoalkyl, sulfhydryl, thioalkyl, alkylthio, sulfonyl, C₁-C₆ straight or branched chain alkyl, C₂-C₆ straight or branched chain alkenyl or alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or CO₂R⁴ where R⁴ is hydrogen or C₁-C₉ straight or branched chain alkyl or alkenyl;

or a pharmaceutically acceptable salt, ester or solvate thereof.

22. The method of claim 21, wherein R₂ is a carbocycle or heterocycle containing any combination of CH₂, O, S, or N in any chemically stable oxidation state, wherein

any of the atoms of said ring structure are optionally substituted in one or more positions with R^3 .

23. The method of claim 21, wherein R_2 is selected from the following group:



where the atoms of said ring structure may be optionally substituted at one or more positions with R^3 .

24. The method of claim 21, wherein R_2 is selected from the group consisting of:

$-\text{COOH}$, $-\text{SO}_3\text{H}$, $-\text{SO}_2\text{HNR}^3$, $-\text{PO}_2(\text{R}^3)_2$, $-\text{CN}$, $-\text{PO}_3(\text{R}^3)_2$, $-\text{OR}^3$, $-\text{SR}^3$, $-\text{NHCOR}^3$, $-\text{N}(\text{R}^3)_2$, $-\text{CON}(\text{R}^3)_2$, $-\text{CONH}(\text{O})\text{R}^3$, $-\text{CONHNHSO}_2\text{R}^3$, $-\text{COHNSO}_2\text{R}^3$, and $-\text{CONR}^3\text{CN}$.

25. The method of claim 14, wherein the N-linked sulfonamide of an N-heterocyclic carboxylic acid compound is selected from the group consisting of compounds 1-97.

26. The method of claim 14, further comprising administering a neurotrophic factor different from formula (I).

27. The method of claim 26, wherein said neurotrophic factor different from formula (I) is selected from the group consisting of neurotrophic growth factor, brain derived growth factor, glial derived growth factor, ciliary neurotrophic factor, insulin growth factor and active truncated derivatives thereof, acidic fibroblast growth factor, basic fibroblast growth factor, platelet-derived growth factors, neurotrophin-3, and neurotrophin 4/5.

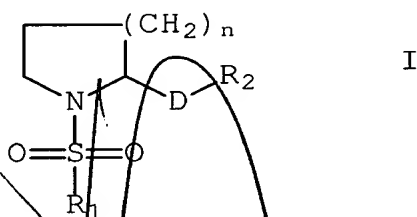
28. A method of stimulating growth of damaged peripheral nerves, comprising:

administering to damaged peripheral nerves a therapeutically effective amount of an N-linked sulfonamide of an N-heterocyclic carboxylic acid or carboxylic acid isostere to stimulate or promote growth

of the damaged peripheral nerves.

29. The method of claim 28, wherein the N-linked sulfonamide of an N-heterocyclic carboxylic acid or carboxylic acid isostere is non-immunosuppressive.

30. The method of claim 28, wherein the N-linked sulfonamide of an N-heterocyclic carboxylic acid or carboxylic acid isostere comprises a compound of formula (I):



where

n is 1-3;

R₁ is selected from the group consisting of hydrogen, C₁-C₉ straight or branched chain alkyl, C₂-C₉ straight or branched chain alkenyl, aryl, heteroaryl, carbocycle, or heterocycle;

D is a bond, or a C₁-C₁₀ straight or branched chain alkyl, C₂-C₁₀ alkenyl or C₂-C₁₀ alkynyl;

R₂ is a carboxylic acid or a carboxylic acid isostere; wherein said alkyl, alkenyl, alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or carboxylic acid isostere is optionally substituted with one or more substituents selected from R³, where

R³ is hydrogen, hydroxy, halo, haloalkyl, thiocarbonyl, alkoxy, alkenoxy, alkylaryloxy, aryloxy, arylalkyloxy, cyano, nitro, imino, alkylamino, aminoalkyl, sulfhydryl, thioalkyl, alkylthio, sulfonyl, C₁-C₆ straight or

862027 92240260

branched chain alkyl, C₂-C₆ straight or branched chain alkenyl or alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or CO₂R⁴ where R⁴ is hydrogen or C₁-C₉ straight or branched chain alkyl or alkenyl;
5 or a pharmaceutically acceptable salt, ester or solvate thereof.

10 31. The method of claim 30, wherein R₂ is a carbocycle or heterocycle containing any combination of CH₂, O, S, or N in any chemically stable oxidation state, wherein any of the atoms of said ring structure are optionally substituted in one or more positions with R³.

15 32. The method of claim 30, wherein R₂ is selected from the following group:

The image displays a collection of chemical structures for nucleobases and nucleosides. A large diagonal line is drawn across the center, crossing out several structures. The structures include:

- Purines:** Adenine (top left), Guanine (top center), Cytosine (top right), and Uracil (middle right).
- Pyrimidines:** Thymine (middle left), Cytosine (middle center), Uracil (middle right), and Thymine (bottom right).
- Nucleosides:** Adenosine (bottom left), Guanosine (bottom center), and Cytidine (bottom right).
- Other structures:** A structure with a carboxylic acid group (top center), a structure with a hydroxyl group (top right), a structure with a thiol group (middle left), a structure with a carbonyl group (middle center), a structure with a carbonyl group (middle right), a structure with a carbonyl group (bottom left), a structure with a carbonyl group (bottom center), and a structure with a carbonyl group (bottom right).

where the atoms of said ring structure may be optionally substituted at one or more positions with R^3 .

33. The method of claim 30, wherein R_2 is selected from the group consisting of:

-COOH, -SO₃H, -SO₂HNR³, -PO₂(R³)₂, -CN, -PO₃(R³)₂, -OR³, -SR³, -NHCO³R³, -N(R³)₂, -CON(R³)₂, -CONH(O)R³, -CONHNHSO₂R³, -COHNSO₂R³, and -CONR³CN.

34. The method of claim 28, wherein the N-linked sulfonamide of an N-heterocyclic carboxylic acid compound is selected from the group consisting of compounds 1-97.

35. The method of claim 28, further comprising administering a neurotrophic factor different from formula (I).

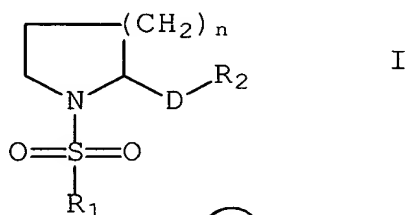
36. The method of claim 35, wherein said neurotrophic factor different from formula (I) is selected from the group consisting of neurotrophic growth factor, brain derived growth factor, glial derived growth factor, ciliary neurotrophic factor, insulin growth factor and active truncated derivatives thereof, acidic fibroblast growth factor, basic fibroblast growth factor, platelet-derived growth factors, neurotrophin-3, and neurotrophin 4/5.

37. A method for promoting neuronal regeneration and growth in animals, comprising:

administering to an animal a therapeutically effective amount of a neurotrophic N-linked sulfonamide of an N-heterocyclic carboxylic acid or carboxylic acid isostere to promote neuronal regeneration.

38. The method of claim 37, wherein the N-linked sulfonamide of an N-heterocyclic carboxylic acid or carboxylic acid isostere is non-immunosuppressive.

39. The method of claim 37, wherein the N-linked sulfonamide of an N-heterocyclic carboxylic acid or carboxylic acid isostere comprises a compound of formula (I):



where

n is 1-3;

R₁ is selected from the group consisting of hydrogen, C₁-C₉ straight or branched chain alkyl, C₂-C₉ straight or branched chain alkenyl, aryl, heteroaryl, carbocycle, or heterocycle;

D is a bond, or a C₁-C₁₀ straight or branched chain alkyl, C₂-C₁₀ alkenyl or C₂-C₁₀ alkynyl;

R₂ is a carboxylic acid or a carboxylic acid isostere;

wherein said alkyl, alkenyl, alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or carboxylic acid isostere is optionally substituted with one or more substituents selected from R³, where

R³ is hydrogen, hydroxy, halo, haloalkyl, thiocarbonyl, alkoxy, alkenoxy, alkylaryloxy, aryloxy, arylalkyloxy, cyano, nitro, imino, alkylamino, aminoalkyl, sulfhydryl, thioalkyl, alkylthio, sulfonyl, C₁-C₆ straight or branched chain alkyl, C₂-C₆ straight or branched chain alkenyl or alkynyl, aryl, heteroaryl, carbocycle,

heterocycle, or CO_2R^4 where R^4 is hydrogen or $\text{C}_1\text{-C}_9$ straight or branched chain alkyl or alkenyl; or a pharmaceutically acceptable salt, ester or solvate thereof.

40. The method of claim 39, wherein R_2 is a carbocycle or heterocycle containing any combination of CH_2 , O, S, or N in any chemically stable oxidation state, wherein any of the atoms of said ring structure are optionally substituted in one or more positions with R^3 .

41. The method of claim 39, wherein R_2 is selected from the following group:

SECRET 9240260

The image displays a collection of chemical structures for various heterocyclic compounds, primarily nucleobases and nucleosides. A large, thick diagonal line is drawn across the center of the page, from the top-left towards the bottom-right. The structures are arranged in a grid-like fashion around this line. The compounds include:

- Purines:** Adenine (top-left), Guanine (top-center), Cytosine (top-right), and Uracil (middle-right).
- Pyrimidines:** Thymine (middle-left), Cytosine (middle-center), and Uracil (middle-right).
- Nucleosides:** Adenosine (bottom-left), Guanosine (bottom-center), and Cytidine (bottom-right).
- Other Heterocycles:** Imidazole (top-center), Pyrazole (top-right), and Nucleosides with sugar modifications (bottom-left, bottom-center, bottom-right).

The structures are drawn in a standard chemical notation, with atoms represented by letters (C, H, N, O, S) and bonds shown as lines. The diagonal line is a prominent feature, possibly indicating a classification or a specific subset of compounds.

where the atoms of said ring structure may be optionally substituted at one or more positions with R^3 .

42. The method of claim 39, wherein R_2 is selected from the group consisting of:

-COOH, $-SO_3H$, $-SO_2HNR^3$, $-PO_2(R^3)_2$, $-CN$, $-PO_3(R^3)_2$, $-OR^3$, $-SR^3$, $-NHCOR^3$, $-N(R^3)_2$, $-CON(R^3)_2$, $-CONH(O)R^3$, $-CONHNHSO_2R^3$, $-COHNSO_2R^3$, and $-CONR^3CN$.

43. The method of claim 37, wherein the N-linked sulfonamide of an N-heterocyclic carboxylic acid compound is selected from the group consisting of compounds 1-97.

44. The method of claim 37, further comprising administering a neurotrophic factor different from formula (I).

45. The method of claim 44, wherein said neurotrophic factor different from formula (I) is selected from the group consisting of neurotrophic growth factor, brain derived growth factor, glial derived growth factor, ciliary neurotrophic factor, insulin growth factor and active truncated derivatives thereof, acidic fibroblast growth factor, basic fibroblast growth factor, platelet-derived growth factors, neurotrophin-3, and neurotrophin 4/5.

46. A method for preventing neurodegeneration in an animal, comprising:

administering to an animal a therapeutically effective amount of a neurotrophic N-linked sulfonamide of an N-heterocyclic carboxylic acid or carboxylic acid isostere to prevent neurodegeneration.

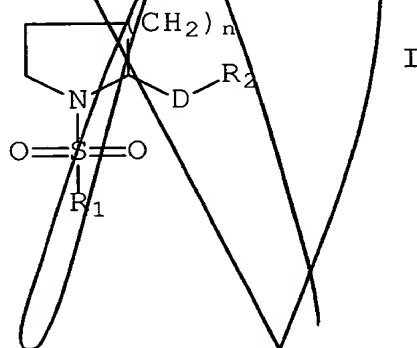
47. The method of claim 46, wherein the neurodegeneration is Alzheimer's disease.

48. The method of claim 46, wherein the neurodegeneration is Parkinson's disease.

49. The method of claim 46, wherein the neurodegeneration is amyotrophic lateral sclerosis.

50. The method of claim 46, wherein the N-linked sulfonamide of an N-heterocyclic carboxylic acid or carboxylic acid isostere is non-immunosuppressive.

51. The method of claim 46, wherein the N-linked sulfonamide of an N-heterocyclic carboxylic acid or carboxylic acid isostere comprises a compound of formula (I):



where

n is 1-3;

R₁ is selected from the group consisting of hydrogen, C₁-C₉ straight or branched chain alkyl, C₂-C₉ straight or branched chain alkenyl, aryl, heteroaryl, carbocycle, or heterocycle;

D is a bond, or a C₁-C₁₀ straight or branched chain alkyl, C₂-C₁₀ alkenyl or C₂-C₁₀ alkynyl;

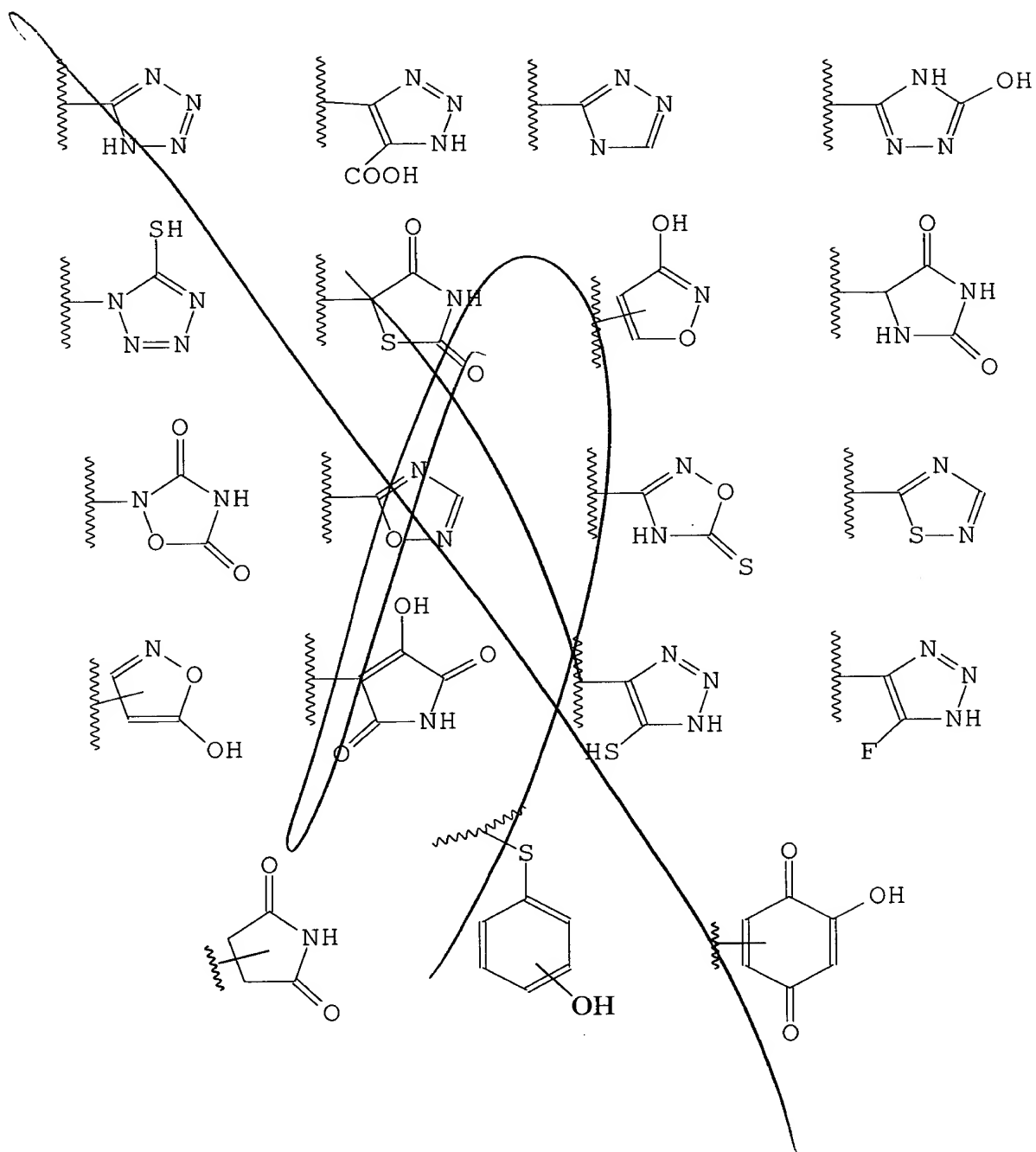
R₂ is a carboxylic acid or a carboxylic acid isostere; wherein said alkyl, alkenyl, alkynyl, aryl, heteroaryl,

carbocycle, heterocycle, or carboxylic acid isostere is optionally substituted with one or more substituents selected from R³, where

R³ is hydrogen, hydroxy, halo, haloalkyl, thiocarbonyl, alkoxy, alkenoxy, alkylaryloxy, aryloxy, arylalkyloxy, cyano, nitro, imino, alkylamino, aminoalkyl, sulfhydryl, thioalkyl, alkylthio, sulfonyl, C₁-C₆ straight or branched chain alkyl, C₂-C₆ straight or branched chain alkenyl or alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or CO₂R⁴ where R⁴ is hydrogen or C₁-C₉ straight or branched chain alkyl or alkenyl; or a pharmaceutically acceptable salt, ester or solvate thereof.

52. The method of claim 51, wherein R₂ is a carbocycle or heterocycle containing any combination of CH₂, O, S, or N in any chemically stable oxidation state, wherein any of the atoms of said ring structure are optionally substituted in one or more positions with R³.

53. The method of claim 51, wherein R₂ is selected from the following group:



where the atoms of said ring structure may be optionally substituted at one or more positions with R³.

54. The method of claim 51, wherein R₂ is selected from the group consisting of:

-COOH, -SO₃H, -SO₂HNR³, -PO₂(R³)₂, -CN, -PO₃(R³)₂, -OR³, -SR³, -NHCOR³, -N(R³)₂, -CON(R³)₂, -CONH(O)R³, -CONHNHSO₂R³, -COHNSO₂R³, and -CONR³CN.

55. The method of claim 46, wherein the N-linked sulfonamide of an N-heterocyclic carboxylic acid compound is selected from the group consisting of compounds 1-97.

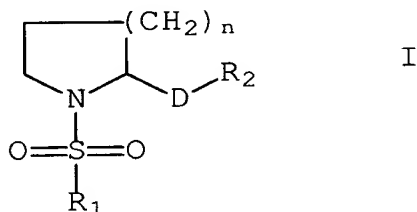
56. The method of claim 46, further comprising administering a neurotrophic factor different from formula (I).

57. The method of claim 56, wherein said neurotrophic factor different from formula (I) is selected from the group consisting of neurotrophic growth factor, brain derived growth factor, glial derived growth factor, ciliary neurotrophic factor, insulin growth factor and active truncated derivatives thereof, acidic fibroblast growth factor, basic fibroblast growth factor, platelet-derived growth factors, neurotrophin-3, and neurotrophin 4/5.

58. A method for treating alopecia or promoting hair growth in an animal, which comprises administering to said animal an effective amount of an N-linked sulfonamide of an N-heterocyclic carboxylic acid or carboxylic acid isostere.

59. The method of claim 58, wherein the N-linked sulfonamide of an N-heterocyclic carboxylic acid or carboxylic acid isostere is non-immunosuppressive.

60. The method of claim 58, wherein the N-linked sulfonamide of an N-heterocyclic carboxylic acid or carboxylic acid isostere is a compound of formula (I):



where

n is 1-3;

R₁ is selected from the group consisting of hydrogen, C₁-C₉ straight or branched chain alkyl, C₂-C₉ straight or branched chain alkenyl, aryl, heteroaryl, carbocycle, or heterocycle;

D is a bond, or a C₁-C₁₀ straight or branched chain alkyl, C₂-C₁₀ alkenyl or C₂-C₁₀ alkynyl;

R₂ is a carboxylic acid or a carboxylic acid isostere; wherein said alkyl, alkenyl, alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or carboxylic acid isostere is optionally substituted with one or more substituents selected from R³, where

R³ is hydrogen, hydroxy, halo, haloalkyl, thiocarbonyl, alkoxy, alkenoxy, alkylaryloxy, aryloxy, arylalkyloxy, cyano, nitro, imino, alkylamino, aminoalkyl, sulfhydryl, thioalkyl, alkylthio, sulfonyl, C₁-C₆ straight or branched chain alkyl, C₂-C₆ straight or branched chain alkenyl or alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or CO₂R⁴ where R⁴ is hydrogen or C₁-C₉

straight or branched chain alkyl or alkenyl;
or a pharmaceutically acceptable salt, ester or solvate
thereof.

5 61. The method of claim 60, wherein R_2 is a carbocycle
or heterocycle containing any combination of CH_2 , O, S,
or N in any chemically stable oxidation state, wherein
any of the atoms of said ring structure are optionally
substituted in one or more positions with R^3 .

10 62. The method of claim 60, wherein R_2 is selected from
the following group:

The image displays a collection of chemical structures for various heterocyclic compounds, primarily nucleobases and nucleosides. A large diagonal line is drawn across the center, crossing out several structures. The structures include:

- Top row:**
 - Adenine (a purine base) with a wavy line at the 9-position.
 - Guanine (a purine base) with a wavy line at the 9-position and a carboxylic acid group at the 2-position.
 - Uracil (a pyrimidine base) with a wavy line at the 5-position.
 - Thymine (a pyrimidine base) with a wavy line at the 5-position and a methyl group at the 5-position.
- Second row:**
 - Cytosine (a pyrimidine base) with a wavy line at the 4-position and an amino group at the 4-position.
 - Uridine (a nucleoside) with a wavy line at the 5-position and a uracil base.
 - Thymidine (a nucleoside) with a wavy line at the 5-position and a thymine base.
- Third row:**
 - Adenosine (a nucleoside) with a wavy line at the 5-position and an adenine base.
 - Uridine (a nucleoside) with a wavy line at the 5-position and a uracil base.
 - Thymidine (a nucleoside) with a wavy line at the 5-position and a thymine base.
- Fourth row:**
 - Cytidine (a nucleoside) with a wavy line at the 5-position and a cytosine base.
 - Uridine (a nucleoside) with a wavy line at the 5-position and a uracil base.
 - Thymidine (a nucleoside) with a wavy line at the 5-position and a thymine base.
- Fifth row:**
 - Adenosine (a nucleoside) with a wavy line at the 5-position and an adenine base.
 - Uridine (a nucleoside) with a wavy line at the 5-position and a uracil base.
 - Thymidine (a nucleoside) with a wavy line at the 5-position and a thymine base.
- Sixth row:**
 - Cytidine (a nucleoside) with a wavy line at the 5-position and a cytosine base.
 - Uridine (a nucleoside) with a wavy line at the 5-position and a uracil base.
 - Thymidine (a nucleoside) with a wavy line at the 5-position and a thymine base.
- Seventh row:**
 - Adenosine (a nucleoside) with a wavy line at the 5-position and an adenine base.
 - Uridine (a nucleoside) with a wavy line at the 5-position and a uracil base.
 - Thymidine (a nucleoside) with a wavy line at the 5-position and a thymine base.
- Eighth row:**
 - Cytidine (a nucleoside) with a wavy line at the 5-position and a cytosine base.
 - Uridine (a nucleoside) with a wavy line at the 5-position and a uracil base.
 - Thymidine (a nucleoside) with a wavy line at the 5-position and a thymine base.
- Ninth row:**
 - Adenosine (a nucleoside) with a wavy line at the 5-position and an adenine base.
 - Uridine (a nucleoside) with a wavy line at the 5-position and a uracil base.
 - Thymidine (a nucleoside) with a wavy line at the 5-position and a thymine base.
- Tenth row:**
 - Cytidine (a nucleoside) with a wavy line at the 5-position and a cytosine base.
 - Uridine (a nucleoside) with a wavy line at the 5-position and a uracil base.
 - Thymidine (a nucleoside) with a wavy line at the 5-position and a thymine base.

where the atoms of said ring structure may be optionally substituted at one or more positions with R³.

63. The method of claim 60, wherein R₂ is selected from the group consisting of

-COOH, -SO₃H, -SO₂HNR³, -PO₂(R³)₂, -CN, -PO₃(R³)₂, -OR³, -SR³, -NHCOR³, -N(R³)₂, -CON(R³)₂, -CONH(O)R³, -CONHNHSO₂R³, -COHNSO₂R³, and -CONR³CN.

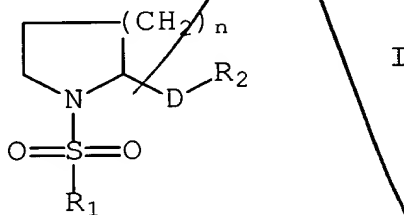
64. The method of claim 58, wherein the carboxylic acid or carboxylic acid isostere is selected from the group consisting of compounds 1-97.

65. A pharmaceutical composition comprising:

- (i) an effective amount of a N-linked sulfonamide of an N-heterocyclic carboxylic acid or carboxylic acid isostere for treating alopecia or promoting hair growth in an animal; and
- (ii) a pharmaceutically acceptable carrier.

66. The pharmaceutical composition of claim 65, wherein the N-linked sulfonamide of an N-heterocyclic carboxylic acid or carboxylic acid isostere is non-immunosuppressive.

67. The composition of claim 65, wherein the carboxylic acid or carboxylic acid isostere is a compound of formula (I):



where

n is 1-3;

R₁ is selected from the group consisting of hydrogen, C₁-C₉ straight or branched chain alkyl, C₂-C₉ straight or branched chain alkenyl, aryl, heteroaryl, carbocycle, or heterocycle;

D is a bond, or a C₁-C₁₀ straight or branched chain alkyl, C₂-C₁₀ alkenyl or C₂-C₁₀ alkynyl;

R₂ is a carboxylic acid or a carboxylic acid isostere;

wherein said alkyl, alkenyl, alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or carboxylic acid isostere is optionally substituted with one or more substituents selected from R³, where

R³ is hydrogen, hydroxy, halo, haloalkyl, thiocarbonyl, alkoxy, alkenoxy, alkylaryloxy, aryloxy, arylalkyloxy, cyano, nitro, imino, alkylamino, aminoalkyl, sulfhydryl, thioalkyl, alkylthio, sulfonyl, C₁-C₆ straight or branched chain alkyl, C₂-C₆ straight or branched chain alkenyl or alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or CO₂R⁴ where R⁴ is hydrogen or C₁-C₉ straight or branched chain alkyl or alkenyl;

or a pharmaceutically acceptable salt, ester or solvate thereof.

68. The composition of claim 67, wherein R₂ is a carbocycle or heterocycle containing any combination of CH₂, O, S, or N in any chemically stable oxidation state, wherein any of the atoms of said ring structure are optionally substituted in one or more positions with R³.

69. The composition of claim 67, wherein R₂ is selected from the following group:

The image displays a collection of chemical structures for various heterocyclic compounds, likely nucleobases and nucleosides, arranged in a grid-like fashion. Each structure is connected to a wavy line, indicating its attachment point to a polymer or other molecule. A large, bold diagonal line is drawn across the entire set of structures, from the top-left to the bottom-right.

The structures include:

- Top row:**
 - A purine derivative with a wavy line at the 9-position.
 - A pyrimidine-2,4-dicarboxylic acid derivative with a wavy line at the 5-position.
 - A pyrimidine derivative with a wavy line at the 2-position.
 - A pyrimidine-2,4-diol derivative with a wavy line at the 5-position.
- Second row:**
 - A thiazine derivative with a wavy line at the 2-position.
 - A thiazolidine derivative with a wavy line at the 4-position.
 - A furan derivative with a wavy line at the 2-position.
 - A pyrimidine-2,4-dione derivative with a wavy line at the 5-position.
- Third row:**
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
- Fourth row:**
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
- Fifth row:**
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
- Sixth row:**
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
- Seventh row:**
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
- Eighth row:**
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
- Ninth row:**
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
- Tenth row:**
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
- Eleventh row:**
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
- Twelfth row:**
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
- Thirteenth row:**
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
- Fourteenth row:**
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
- Fifteenth row:**
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
- Sixteenth row:**
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
- Seventeenth row:**
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
- Eighteenth row:**
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
- Nineteenth row:**
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
- Twentieth row:**
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.
 - A pyrazole derivative with a wavy line at the 1-position.
 - A pyrazole derivative with a wavy line at the 3-position.